United States Coast Guard
Office of Investigation and Analysis

Analysis of Fishing Vessel Casualties

A Review of Lost Fishing Vessels and Crew Fatalities, 1994 - 2000

Prepared by David H. Dickey
United States Coast Guard
Compliance Analysis Division (G-MOA-2)
2100 Second Street, S.W.
Washington, DC 20593-0001

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EXECUTIVE SUMMARY

During a three-week period in the winter of 1998/1999 four clam/conch vessels were lost in the Mid-Atlantic waters, which resulted in the deaths of 11 fishermen. After this cluster of accidents, a task force of government and industry representatives was chartered to study trends in fishing vessel (F/V) safety and to make recommendations for reducing loss of life and property. The Task Force's report of March 1999 provided a series of short-term and long-term recommendations[1]. The report also included a high-level review of casualty data for calendar years 1994 – 1998.

Shortly after the Task Force report was released, industry and senior Coast Guard managers requested more details about fishing vessel casualties. The Compliance Analysis Division collaborated with the Fishing Vessel Safety program manager and prepared a follow-on review to provide information about why and how such incidents occurred. That report was distributed in October of 1999. This document is the second edition of the casualty study with newly added data for calendar years 1999 and 2000. The resulting updated data set includes such factors as:

- Operation of the vessel at the time of the incident.
- Geographic or location information of the incident.
- Participation of the vessel in the voluntary exam program and its decal status.
- Causal information about vessel loss, (what went wrong).
- Causal information about deaths and missing persons.
- Assistance by good Samaritan vessels, and
- Availability and use of lifesaving equipment.

Analysis begins with overall summaries of the revised data set. ***The information showed that the majority of fishing vessel losses and deaths occurred in the 17th and 8th Coast Guard Districts.***[2] From this starting point, a more detailed "drill down" analysis is provided on the data in two groupings - vessel losses and personnel casualties. In other words, for each of the two groupings, the broad based information will be examined in increasing detail, in order to "peel back," or focus on, the most significant factors involved in these fishing vessel incidents.

For both vessel losses and personnel casualties, ***it was found that a majority of these incidents were not directly related to fishing operations, but to other activities, such as traveling to or from port. Most often, fishermen are dying because their vessel sank and they found themselves in the water***. Further, the analysis of personnel casualties indicates links between water conditions and the use of lifesaving equipment, especially survival suits. In particular, most of the water exposure deaths were in the 11th, 13th, and 17th

[1] U.S. Coast Guard, *Living To Fish, Dying To Fish*, Fishing Vessel Casualty Task Force Report, Washington, DC, March 1999.

[2] Except where noted, this data is not normalized because reliable vessel and workforce population data is not available for the fishing fleet. We are continuing to work with Federal, State and local agencies to collect this data. With this in mind, fleet size is assumed to be essentially uniform for the period of this study, as will be explained in more detail, later in this document.

Districts, where the water is the coldest year round. Use of survival suits was infrequent in such incidents. However, ***when use of survival suits was reported, more crewmembers survived - nearly double the survival rate.***

Given the Coast Guard's limited authority over fishing vessel design and maintenance, analysis of this data illustrates that when vessels have the safety equipment prescribed by Federal Regulations, and fishermen use the equipment properly, their chances of survival increase significantly.

A. MAIN POINTS

1. Overall, the majority of vessel losses and deaths occurred in the 17th and 8th Districts, (p. 8).

2. The Coast Guard documented just over 80% of the lost vessels. Because population data is readily available for documented vessels, it was possible to develop accident rates for this major sub-group. Among the documented vessels, the following was found:

   - Accident rates increase with vessel length, (pg. 13).
   - Accident rates increase with vessel age, (pg. 14).
   - Wood vessels are lost the most frequently, followed by steel and fiberglass, (pg. 14).
   - Steel vessels tend to be longer in length and older than fiberglass vessels, (pp. 15-16).

3. Fishing activities are not the most significant factor in vessel loss, (pg. 20).

4. The biggest cause of fishing vessel loss is structural and mechanical failures during both underway and fishing operations. Such incidents resulted in flooding, loss of propulsion, and fire/explosion, (pg. 21).

5. The second largest factor in fishing vessel loss is navigational and seamanship error, which resulted in allisions, collisions, and groundings, (pg. 21).

6. When fishing is in progress, most vessel losses (78%) are attributed to navigational and seamanship errors, and to hull or machinery problems - causes that are not unique to commercial fishing, (pg. 21).

7. When fishing operations are in progress, the most apparent fishery-specific factor is capsizings. Shifting cargo, overloading, or catching of gear on submerged obstructions were reported for 23 of 33 capsizings, (p. 21).

8. Examination of both the nature of fishing vessel deaths and the events leading to death confirmed that water exposure was, by far, the most significant factor in personnel loss, (pp. 29-30).

9. Deaths from water exposure were dramatically higher in the 11th, 13th and 17th Districts than in any other region because of more severe environmental conditions, (pg. 31).

10. Of the West Coast fatalities associated with a vessel loss, two-thirds of the occurred between the months of October and January, (pg. 33).

11. Loss of lives was much lower among those vessels that received a safety decal. When deaths did occur, the vessel was lost suddenly with little time to respond, (pp. 34-35).

12. Fishermen survive nearly twice as often when lifesaving equipment is used, (p. 35).

13. A significant, but unknown, number of crewmember fatalities were prevented, especially in the cold west coast waters, because Good Samaritan vessels were present, for nearly 3 of every 10 vessels lost. Hypothetically, as many as 454 fatalities may have been prevented, (pp. 36-37).

14. Vessel losses and fatalities dropped sharply in 1999 to the lowest point in at least 7 years. There is a high correlation between vessel losses and fatalities, (pp. 38-39).

B. INTRODUCTION

After the Fishing Vessel Task Force delivered its report in the spring of 1999, there were two follow-on reviews of the Task Force data. The purpose of those reviews was to gather additional details about such casualties to learn more about why lives and vessels were being lost. For consistency, the data set was limited to the same casualty records used by the F/V Task Force, which covered the period 1994 - 1998, inclusive. The Task Force data set included all known reports of vessel loss and deaths/missing persons. This report is the second edition of the casualty study, which includes casualty reports for calendar years 1999 and 2000.

The Data Source

The data for this review was extracted from the Headquarters Marine Safety Management System (MSMS), which uses the Marine Safety Information System (MSIS) as its source. MSIS was the Coast Guard's repository of marine casualty data from January 1, 1992 through December 13, 2001. To get the most complete data set possible, records of the Fishing Vessel Safety program office were used to crosscheck MSMS query results.

The following criteria were used to extract fishing vessel casualty data from the MSMS database:

- The service of the vessel, at the time of the casualty, was recorded as "FISHING BOAT."
- At least one crewmember was listed as dead or missing, OR;
- The vessel was reported as a total loss, AND;
- The report of investigation was completed and closed by the investigating unit.

Quality Control - As part of the case review, described in more detail below, case reports not meeting the criteria for this study were eliminated. This included the following:

- Duplicate records.
- Vessels that were damaged, but not a total loss.
- Vessels that were misclassified or not being used for fishing.
- Fatalities from natural causes, (e.g., heart attack, stroke, etc.).

Assumptions and Constraints

Data Collection - It is important to note that policy does not specifically require all of the information needed for this study, although MSIS was capable of recording most of the information in various case supplements. In fact, investigating officers have significant discretion in the amount of information collected based on the severity of the incident, reporting policy, and other factors.

Often, vessel casualties were only investigated because they resulted in pollution - not to determine the cause of the vessel loss. Thus, each case report, including the narrative entries of the MSIS reports, was reviewed in order to fill in missing data items, which provided many additional details. Results were dependent upon the writing style and thoroughness of the investigating officer, which varied from a few brief sentences to

many typed pages. Unfortunately, this case review process often resulted in values being shown as "Unknown." Of course, more automated and easily repeatable methods of data analysis are preferred to the labor-intensive procedures used in this study. Changes in policy, data reporting, or data quality procedures may be necessary to support future data analysis requirements.

Missing Values - In many cases where a vessel was lost and all persons on board were rescued, no details were provided about the rescue, the use of lifesaving equipment, or the number of persons on board. For these cases, the lifesaving information is recorded as "Unknown" and three persons were assumed to be on board the vessel. This assumption is based upon an examination of the records where persons on board were reported. The average of those values is 2.7. The data set shows zero for the persons on board only when the vessel was unmanned, e.g., the vessel burned while moored, sank while being towed, etc.

Population v. Sample Size - For purposes of this study, the data set is considered to be the entire population of lost fishing vessels and personnel casualties. These are incidents with serious consequences and will rarely escape the Coast Guard's attention. It is believed that any cases missing from the data, due to lack of notification, clerical, or other error, are few in number and will not affect the results of this study. Further, the number of records available for analysis is large - 907 for lost vessels and 466 for personnel loss, which would give results very close to a much larger population, (i.e., the "Central Limit Theorem" of statistics). Of more concern to this study are the previously mentioned missing values that had to be recorded as "unknown."

Normalization - As noted in the Fishing Vessel Task Force report, demographics about the size and composition of the fishing industry, especially the number of workers, is not readily available. Further, recent attempts to estimate the worker population have resulted in widely varying estimates. Thus, most of the figures presented in this document are "as reported" to Coast Guard information systems without statistical normalization or leveling. (An exception to this is a review of the subset of documented vessel losses. The population of documented vessels is in the Coast Guard's information system.) No comparisons with other industries were made in this report. For analysis purposes, it is assumed that the number of vessels and workers in commercial fishing did not change significantly between 1994 and 2000. For 1996, 1997 and 1998, surveys by Coast Guard Personnel[3] estimated the number of fishing vessels as 106,647; 103,774; and 102,075. From the highest to lowest value, across all three years; a difference of 4.3%.

The Office of Compliance, Marine Safety and Environmental Protection Directorate has recognized the need for better population data and intends to sponsor research in this area, as a long term goal of their Fishing Vessel Safety Action Plan.

[3] U. S. Coast Guard, Office of Compliance, Marine Safety and Environmental Protection Directorate, unpublished fishing vessel safety statistics.

Reviewer Interpretation/Bias - In the MSIS system, investigating officers can describe a casualty as a series of events, each with associated causes. When available, the case reviewers for this study used the first event as the cause of vessel loss or fatality. For incidents with no reported events, the case reviewers determined the cause by reading other information in the case report. For example, a vessel might suffer a hull failure, followed by flooding, then sinking. In this example, an investigator might report, given the best available information, the first event as flooding, without knowing of the hull failure event. If the investigator provides no events, a case reviewer may determine the cause of vessel loss as sinking, without knowing of the hull failure or the flooding. This, of course, may insert additional bias into the data. However, this method was preferred to leaving a large number of values as "unknown."

C. SUMMARY STATISTICS

For the seven-year period from 1994 through 2000, there were 907 lost vessels and 466 fatalities. Of those fatalities, 218 occurred at the same time a vessel was lost. This is an average of 130 lost vessels and 31 fatalities per year.

Vessel losses and deaths, by District, are shown in the first two tables. In each of the tables, the highest number of casualties occurred in the 17th (Alaska) and 8th (Gulf of Mexico) Districts

Lost Fishing Vessels By Year And District								
District	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Grand Total**
17	42	26	47	38	31	43	22	249
08	25	23	29	25	21	19	14	156
07	21	13	20	23	20	17	14	128
11	24	13	24	20	14	16	9	120
01	28	17	17	15	6	10	14	107
13	9	15	13	11	13	8	4	73
05	2	7	11	4	13	6	7	50
14	2	3	4	2	6	3	1	21
09			1		1	1		3
Grand Total	153	117	166	138	125	123	85	907

Table 1

Fishing Fatalities, By Year And District								
District	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Grand Total**
17	18	17	22	3	13	19	5	97
08	6	16	17	12	11	16	4	82
11	17	5	11	11	12	12	3	71
01	14	7	8	11	8	6	11	65
13	10	9	6	10	7	5	5	52
05	3	4	8	4	6	12	3	40
07	7	2	3	9	7	3	5	36
14		4	8	2	3		2	19
09					4			4
Grand Total	75	64	83	62	71	73	38	466

Table 2

Vessel Design and Fishery Information

In the previous edition of this report, casualty data was compared to vessel type/design and fishery. It was observed that the MSIS database was not designed to collect fishery information directly, which resulted in a large number of "unknown" values. Further, vessel design information included a built-in bias. The MSIS system did not provide enough choices to adequately describe fishing vessel design. As such, vessel type and fishery information was found to be questionable and is not included in this report.

Detailed Analysis

In the next section of this document, the casualty data will be examined in greater detail to learn more about how and why lives and vessels are being lost. The analysis is presented in two parts - lost vessels and personnel casualties. In general, each area of analysis begins with simple descriptive statistics of the casualty data and is followed by more detailed examination of selected items. This "drill down" approach is used as a means to identify the factors that contributed most to fishing vessel casualties.

D. LOST VESSELS

Overview

After extracting and examining the MSIS casualty data, as described earlier, the Coast Guard database showed that 907 fishing vessels were lost from calendar year 1994 through 2000. On average, 130 vessels were lost each year. The maximum and minimum number of vessel losses was 166 and 85 in calendar years 1996 and 2000, respectively. Of the 907 vessels, 726, or just over 80%, had Certificates of Documentation issued by the Coast Guard, instead of state registration numbers. Because population data is readily available for documented vessels, some additional analyses are possible as shown on the following pages.

The question might be whether the state numbered vessel casualties are under-reported, thus skewing the accident rate towards documented vessels. Total loss of a vessel is a serious occurrence, which will rarely go unreported. Further, Investigating Officers learn of such incidents from the Search and Rescue units of the Coast Guard and other sources, even when the vessel's owner fails to submit a report. Additionally, a preliminary report by the First Coast Guard District showed a virtually identical case distribution to that shown in this paper. It was found that 78% of all First District fishing vessel casualties, whether or not the vessel was lost, occurred on documented vessels[4]. Thus, the data set is considered complete and unbiased in this respect.

Losses By Vessel Length

The histogram in Figure 1 shows the number of vessels lost, by length. Two sets of bars are included to show state numbered and Coast Guard documented vessels separately. Each bar, except for the first and last, represents an increment of ten feet. The shortest vessel was a 13 ft skiff used for lobstering in Maine, and the longest was a 239 ft. tuna seiner operating in the Pacific Ocean. Also, there were 95 state numbered vessels for which no length was reported. Based on a review of state numbered vessels in the MSIS database, each of those vessels is expected to be less than 30 feet in length[5]. Thus, the population of lost vessels has an average length of 51.5 feet, a median length of 46.8 feet; and 53%, or 482, of them were between 20 and 50 feet in length, excluding the vessels of unknown length.

It is difficult to draw conclusions about this data without having population statistics for comparison. The distribution of casualties may simply be representative of the whole U.S. fishing fleet. In other words, it may be that most of the vessel losses are between 20 and 50 feet, because most of the fleet is in that size range. As noted earlier, no reliable population data is available for state numbered vessels. However, 80% of all lost vessels were documented by the Coast Guard and, fortunately, good population data is available for that group. Thus, the documented vessel casualties will be examined next.

[4] *State Registered v. Documented. A study of Disparity in Safety Carriage Equipment Requirements.* (Draft). First Coast Guard District Marine Safety Division. Authors of the report described an aggressive program in the First district to identify all fishing vessel casualties, using a variety of sources. Cited with permission of the authors.

[5] There were 2,247 state numbered vessels with lengths reported in the MSIS database. The length range in that group was 11.6 to 74 feet, with 94% of the vessels between 11.6 and 40 feet. The average vessel length was 27 feet.

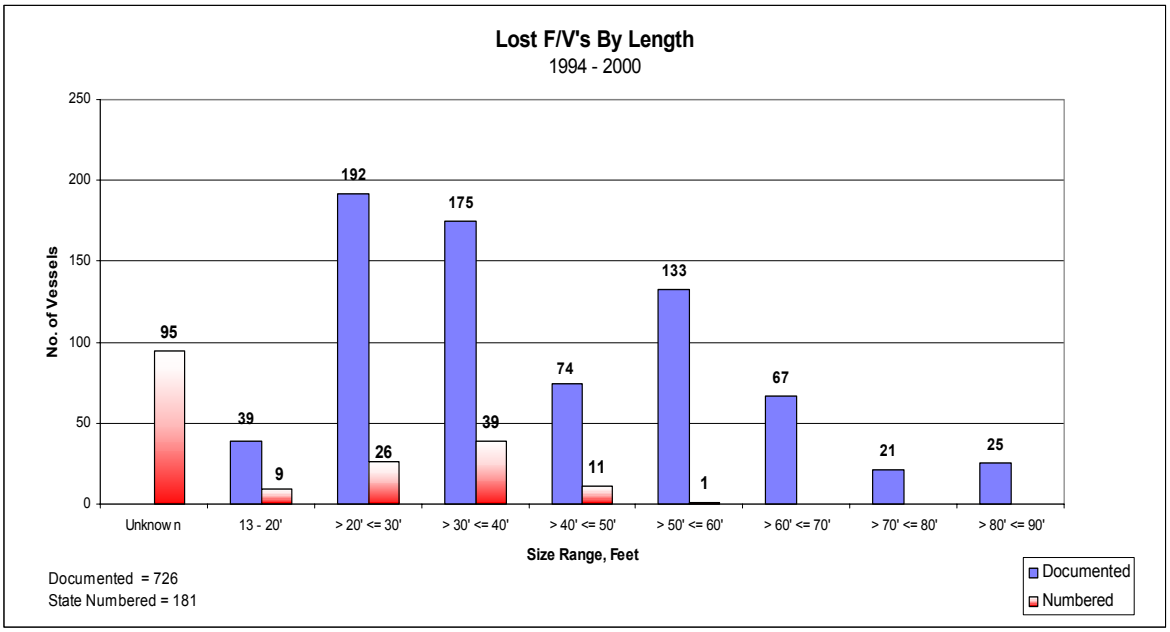

Figure 1

Loss of Documented vessels

Documented vessel losses by District and year are shown in Table 3. Like the overall figures shown in Table 1, the highest number of casualties occurred in the 17th and 8th Districts. In fact, the distribution of documented vessel losses by District is virtually identical to the overall numbers, as shown on Figure 2. Thus, even when state numbered cases are removed, the distribution among the Districts (i.e., by geographic regions) is unchanged.

Documented F/V Losses, By Year And District								
District	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Grand Total**
17	34	24	44	29	28	40	17	216
08	19	18	23	23	18	18	12	131
07	17	13	17	19	18	14	11	109
11	11	9	18	12	8	12	7	77
01	22	10	10	8	4	7	10	71
13	8	10	10	11	8	6	4	57
05	1	7	9	2	13	4	7	43
14	2	3	4	2	4	3	1	19
09			1		1	1		3
Grand Total	114	94	136	106	102	105	69	726

Table 3

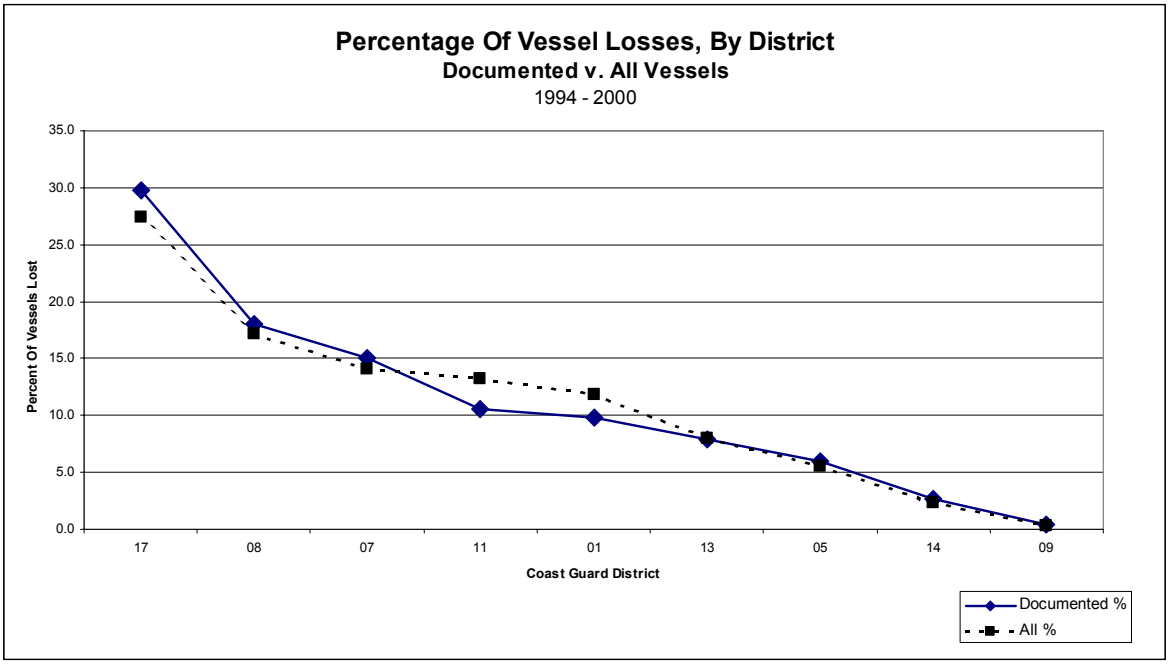

Figure 2

Next, documented vessel losses are shown by age and hull material. For each type of hull material there is a unique pattern. Most fiberglass vessels were 11 to 20 years old when lost, with none over 40 years old[6]. Generally, wood vessels were evenly distributed between 11 and 60 years, while steel vessel losses dropped off sharply after age 30.

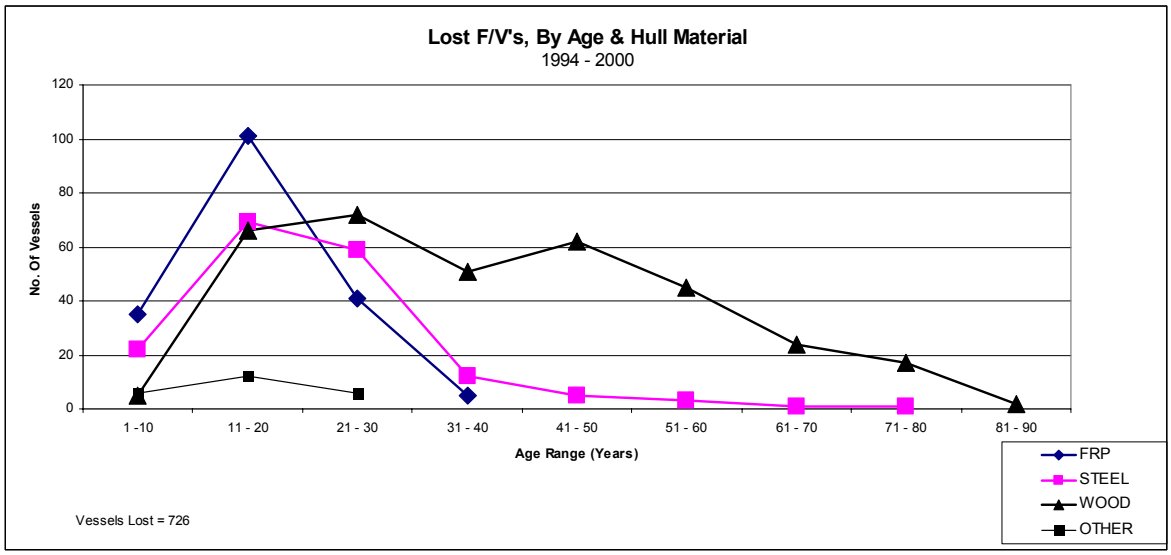

Figure 3

[6] It is commonly known that fiberglass did not go into popular production until the 1960s.

Applying Population Data to Documented Vessel Losses

In addition to casualty reports, the Coast Guard's MSIS database contains the population data for all documented fishing vessels. At the end of calendar year 2000, there were 26,246 active fishing vessels in the MSIS database. Further, the number of documented fishing vessels between 1997 and 2001 was quite constant, ranging from 26,537 to 25,321 or a difference of just 5% over the 5-year period. Thus, the vessel information on file for calendar year 2000 is considered to be the entire population at that time and will be used for the comparisons that follow.

Losses by vessel length are shown again in Figure 4 for the 726 documented vessels. A line has been added, showing the rate of vessel loss per 1000 vessels, for each corresponding length range. These "normalized" figures clearly show that accident rates increase with vessel length, with a sharp spike in the 60 ft. to 70 ft. range. A variety of factors could influence this increase in accident rates. However, the likely explanation is larger vessels generally are capable of operating further from shore, with the potential for longer voyages or exposure to more severe environmental conditions.

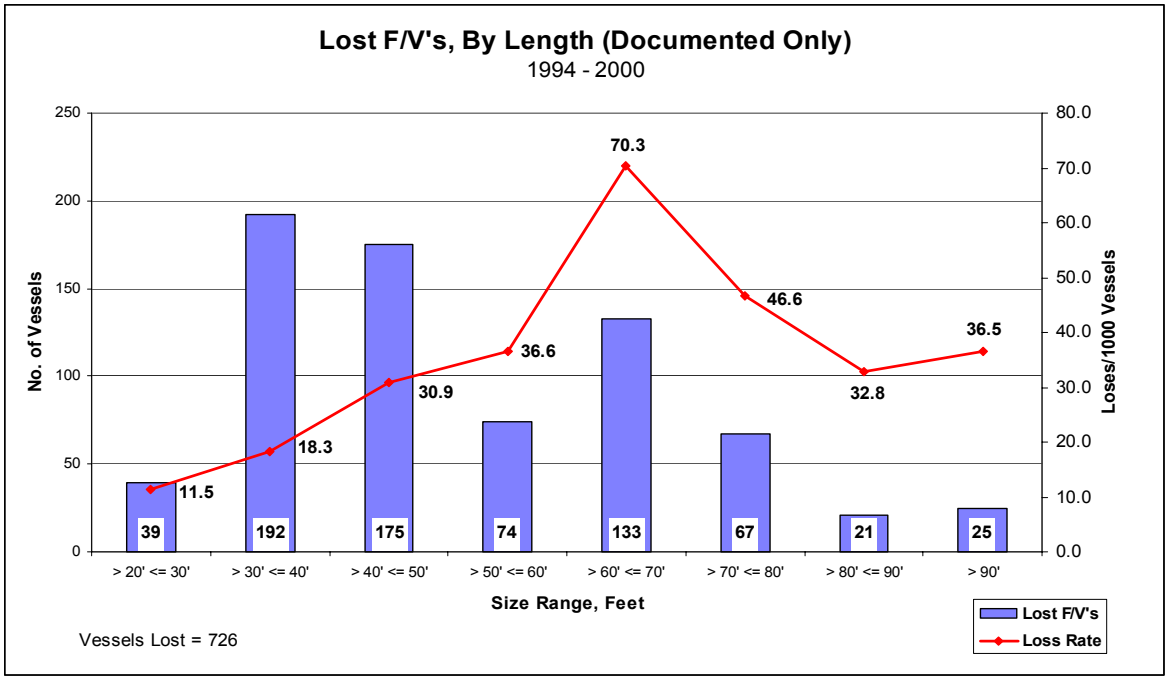

Figure 4

Shown in Figure 5 are vessel losses by age. As expected, the loss rate increased as the vessels get older. However, in this case there was a distinct inverse relationship between the raw vessel counts and the normalized values. Numerically, most of the losses were vessels between 11 and 30 years old with an average age of 28. After age 30 the number of vessels decreased dramatically, but the percentage of the vessel population lost tend to increase steadily with age.[7]

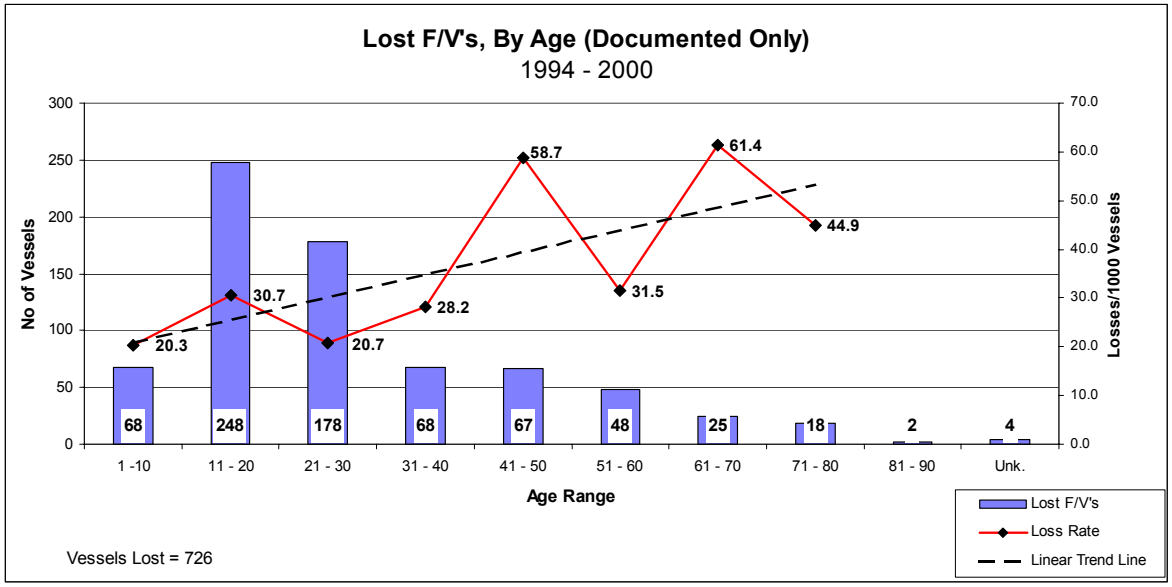

Figure 5

Losses by hull material fell into three discrete groups – wood, steel, and FRP (fiberglass reinforced plastic), the primary materials used to construct fishing vessels. Numerically, lost wood vessels were the highest and about double the number for steel or FRP. The number of lost steel and FRP vessels was essentially equal. The loss rate for steel vessels was nearly double that of FRP. Given that there are twice as many FRP vessels, the loss rate for steel vessels is especially significant. It appears that this difference can be explained by two factors – vessel length and age. A comparison of documented steel and FRP vessels in Figure 7 shows a relatively even distribution of steel vessels above 30 feet in length. Conversely, the documented FRP population is concentrated at about the 30 – 40 foot range with none above 80 feet. Similarly, Figure 8 shows that 19.7 % of the steel vessel population was over 30 years of age versus 3.9% for FRP vessels.

[7] Loss rates were not plotted for vessels over 81 years or "unknown," because they were few in number and statistically unreliable.

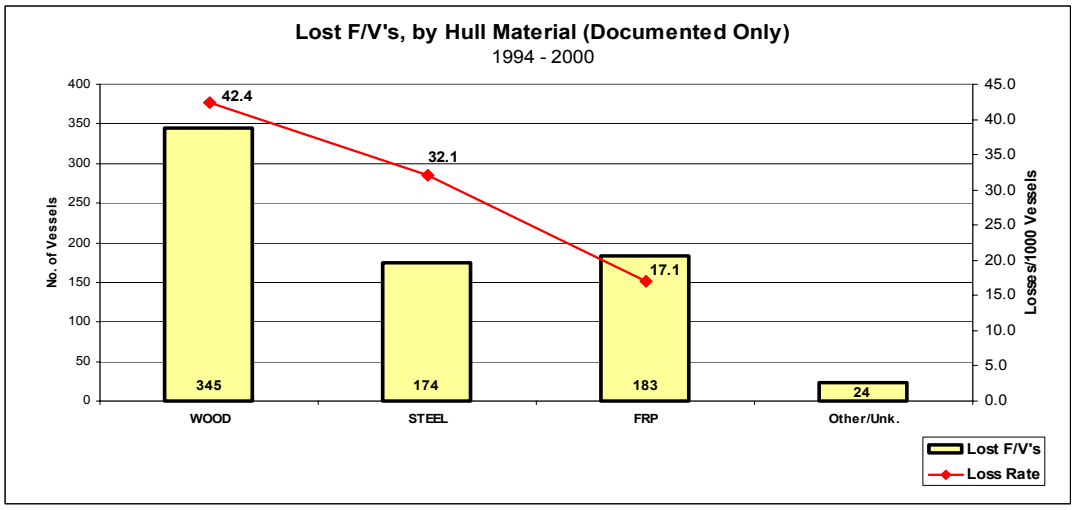

Figure 6

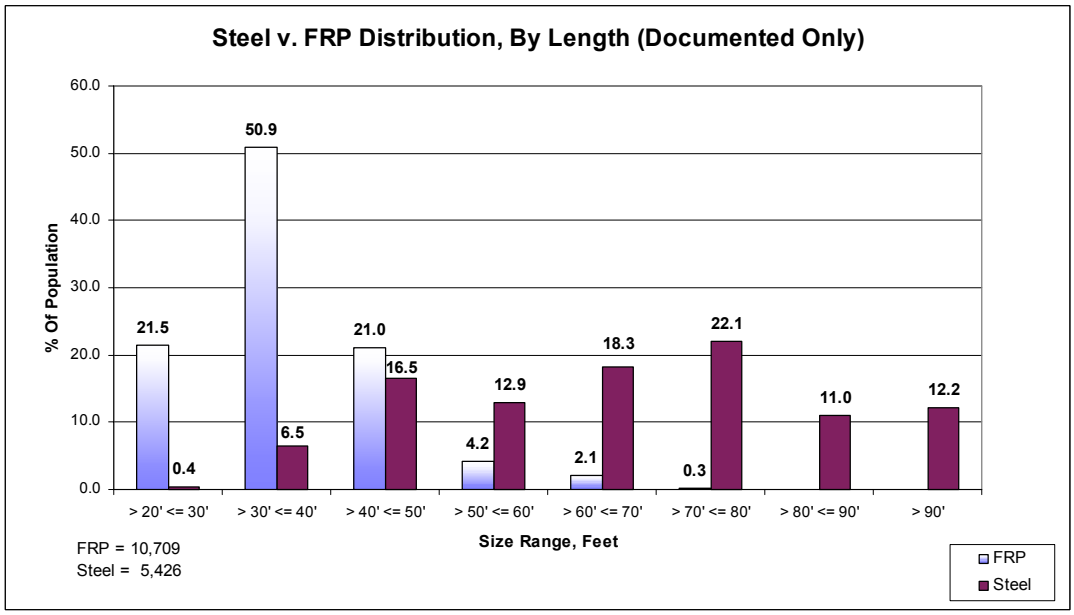

Figure 7

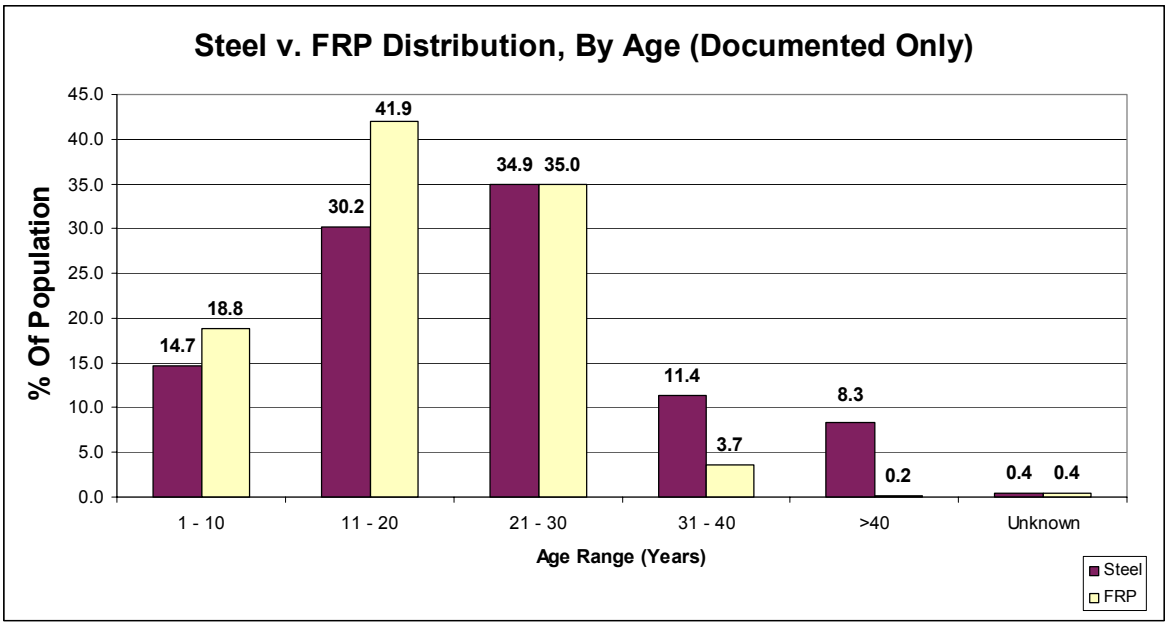

Figure 8

Up to this point, various characteristics of fishing vessels, at the time of their loss, have been presented. The use of population data for documented vessels, which account for 80% of the losses, has provided some indicators of which vessels are most likely to be lost on a nationwide basis. Next, using all 907 lost vessels again, details from the marine safety data will be used to learn more about how such accidents have occurred.

Vessel Operation

Another item recorded in MSIS is "operation," which describes how the vessel was being used at the time a casualty occurred, such as "moored," "anchored," "transiting," etc. Vessel losses, by operation, are summarized in table 4.

Operation	Vessel Count
Transiting	266
Unknown	140
Inbound	112
Anchored	73
Trawling	64
Moored	60
Fishing	45
Hauling gear	43
Outbound	41
Drifting	21
Being towed	14
Setting gear	14
Towing	7
Anchoring	4
Receiving Fuel	1
Tendering	1
Trolling	1
Grand Total	**907**

Table 4

The operations listed here suggest that a number of them are very similar and can be grouped together for further review. The following groupings are deemed appropriate:

Underway/maneuvering = transiting, inbound, outbound, and anchoring (423 vessels).
Fishing Activities = setting gear, hauling gear, trawling, trolling and fishing (167 vessels).
Towing Operations = towing or being towed (21 vessels).
Moored = self-explanatory (60 vessels).
Unknown = The operation was not specified in the investigation report or could not be determined (140 vessels).
Other = anchored, drifting, receiving fuel, or tendering. (96 vessels. Some of the vessels in this grouping may have been engaged in fishing.)

By using the groupings described, the data shows that nearly half, or 423, of the 907 losses involved vessels that were underway or maneuvering. The next most frequent operation, fishing, accounted for only 18%, or 167, of the casualties, followed by "unknown" and "other," as shown in Figure 9. In other words, for every 2 vessels that are lost while fishing, 5 vessels are lost while underway or maneuvering.

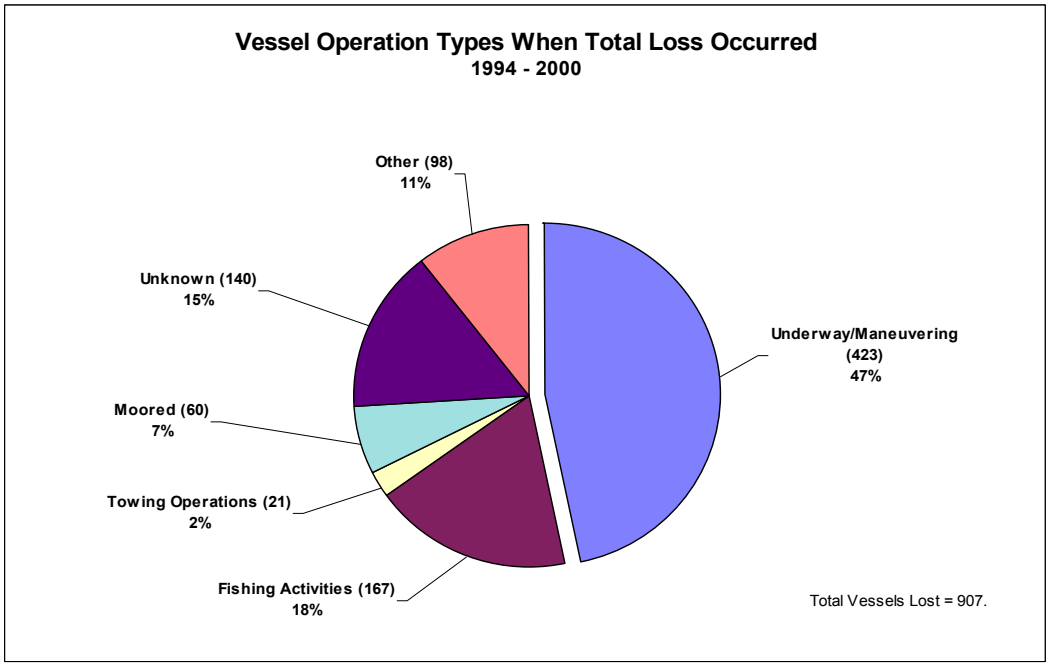

Figure 9

Fishing Employment v. Fishing Operation

Again, Table 4 and Figure 9 describe the *operation* of fishing vessels at the time they were lost. Of course, all of the vessels in this study were *employed* in the fishing industry, and it is recognized that other aspects of commercial fishing may contribute to casualties even when the vessels are in a "non-fishing" mode of operation. For example, a vessel that is overloaded with too many traps may capsize or sink while underway. Clearly, fishery employment a common factor, to some degree, in this and all casualties. But are casualties on fishing vessels engaged in "non-fishing" operations different in some way? Under the same circumstances, would such accidents have occurred if the vessels were in some other industry, such as towing?

Information about the causes of incidents while underway or maneuvering, which account for nearly half of all incidents, will be presented next. Vessels that were moored or engaged in towing operations will not be included because they are deemed to be separate and distinct groups that would involve different causal factors. For example, vessels lost while moored do not need to be concerned with navigation, communications, or lifesaving equipment.

Vessels Lost While Underway & Maneuvering

As described in Figure 9, nearly half of all vessels were lost while underway or maneuvering (423 of 907) and were apparently not directly engaged in fishing operations. Thus, a closer study of this group may be useful in further identifying the most frequent reasons for vessel loss. First, Table 5 summarizes this group of incidents by cause of loss. For this report, cause of loss is the first event in the series of events recorded for the incident. For example, a collision that results in flooding and subsequently to sinking would be recorded by the first event in the chain - collision.

Cause Of Loss While Underway or Maneuvering	***Total***
Allision with charted object	11
Allision with uncharted object	17
Capsized	3
Capsized, deck cargo shifted	4
Capsized, deck overloaded	6
Capsized, freeing ports blocked	3
Capsized, gear caught on obstruction	2
Capsized, hold cargo shifted	6
Capsized, icing	4
Capsized, severe weather	20
Capsized, unknown	1
Collision	19
Explosion	2
fire	2
Fire, aft area	1
Fire, cargo area	1
Fire, engine room	51
Fire, living spaces	4
flooding	13
Flooding hatch cover failed	2
Flooding, aft area	27
Flooding, deck overloaded	1
Flooding, engine room	45
Flooding, forward area	6
Flooding, hatch cover lost	2
Flooding, hole in hull	9
Flooding, lazarette	1
Flooding, midbody area	9
Flooding, plank failed	15
Flooding, struck by wave	3
Grounding, accidental	89
Grounding, intentional	2
Loss of electrical power	4
Loss of vessel control	10
Structural failure, booms	1
Strutural failure, hull	13
Unknown	4
Weather	10
Grand Total:	***423***

Table 5

The previous section concluded with a question about how often "non-fishing" casualties were actually influenced by other aspects of commercial fishing activities, such as overloading the vessel with traps. In reviewing the Table 5, few causes, primarily capsizings, are clearly linked to fishing activities. Those causes are highlighted on the table and account for only 22 vessels, or 5%, of all vessels lost while underway or maneuvering. ***Again, in this view of the data, relatively few of the incidents appear to be unique to the commercial fishing industry.*** The other causes such as accidental grounding are things that will occur on any type of vessel.

As with vessel operation, some of the causes listed on Table 5 are very similar and can be grouped together. The result is shown in Figure 10 and suggests that for vessels underway or maneuvering the primary causes fall into two broad groupings:

- Navigation or seamanship errors, (allisions, collisions, groundings - 138 incidents or 33%) and;
- Vessel's hull or machinery problems, (flooding, fire & explosion, structural failures, and loss of propulsion – 222 incidents or 52%).

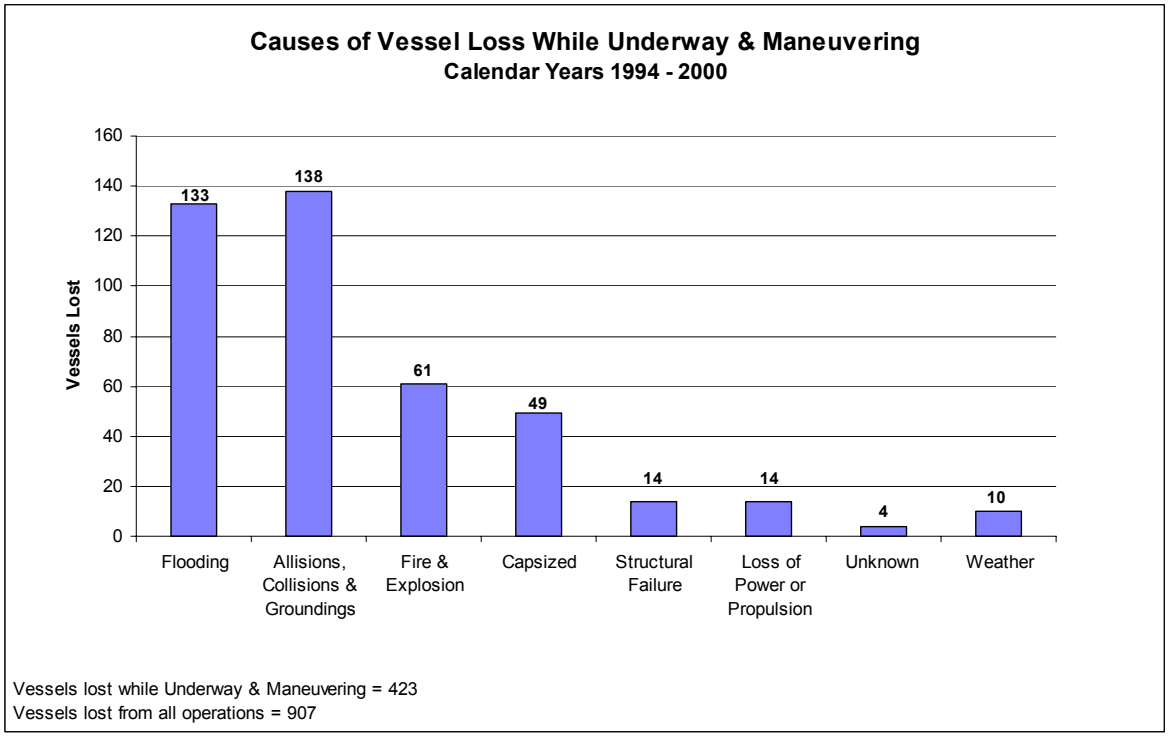

Figure 10

The largest group of vessel losses while underway or maneuvering includes the allisions, collisions and groundings. The MSIS data shows that nearly all of those incidents, 119 of 138 (86%), were attributed to "human factors." Further, 31 of the human factors cases listed fatigue as the more specific explanation, followed by 27 instances of inattention. Another 57 cases were attributed to a combination of navigation and seamanship errors

such as failure to maintain a proper lookout, failure to monitor the vessel's position and collisions due to Rules Of The Road violations. In 12 of the latter 57 cases, the vessel struck an uncharted object. Arguably, those accidents might be considered unpreventable.

In summary, the greatest number of fishing vessels are lost while underway and maneuvering, (not fishing). Of those losses 33% are due to navigational or seamanship errors, while 52% are due to hull or machinery problems. This would suggest that attention be directed in those areas.

Vessels Lost While Fishing

The second largest group of vessel losses, by operation, occurred while fishing was in progress, (i.e., setting gear, hauling gear, trawling, and fishing). This group accounted for 18%, or 167, of the 907 incidents, overall. The causes are shown in Figure 11. Again, hull or machinery problems (flooding, fire & explosion, structural failures, and loss of propulsion) are the largest group, about 60% (100 of 167) of the vessel losses. The next highest cause was capsizings, with 24% of the total, or 33 of the 167 vessels. Allisions, collisions and groundings occurred in 18% of the incidents. This suggests two things:

- Even when fishing is in progress, most vessel losses (78%) are attributed to the areas of navigation, seamanship, and to hull or machinery problems - causes that are not unique to commercial fishing.
- As before, only capsizings show a clear link to fishing activities. Shifting cargo, overloading, or catching of gear on submerged obstructions were reported for 23 of the 33 capsizings. The other 10 incidents were related to severe weather, icing, or no additional detail was provided.

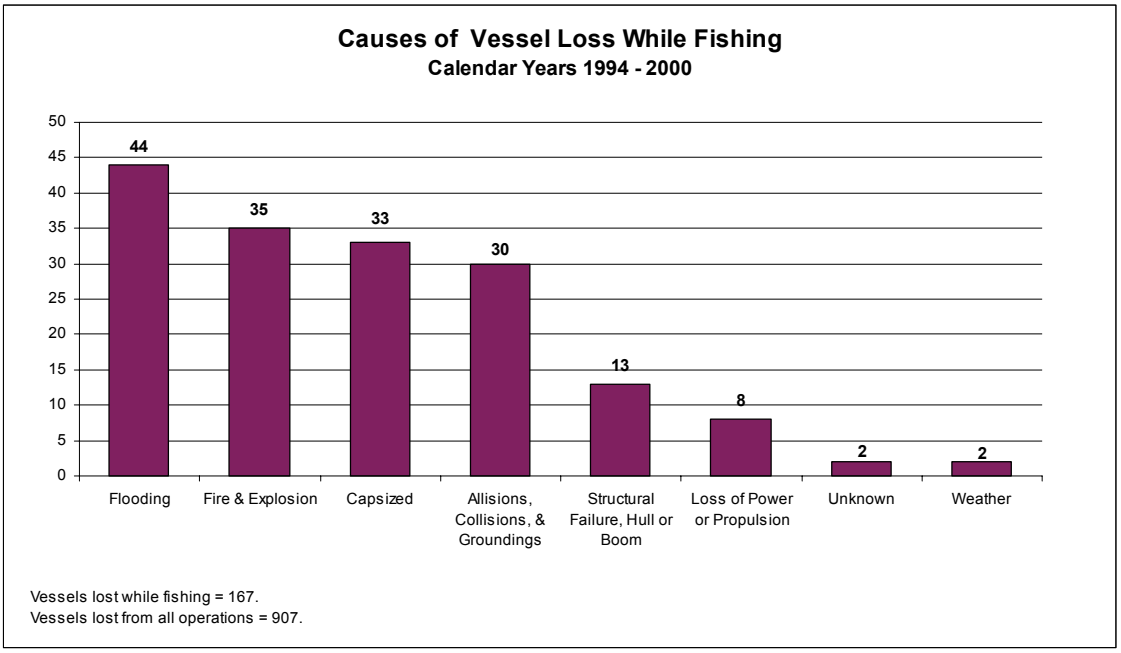

Figure 11

Prior Incidents

Often, prior accidents can indicate the potential for a more serious casualty. For example, a vessel with a history of structural or flooding problems may subsequently experience a more serious failure which cannot be controlled, resulting in total loss. Thus, for the 907 vessels in this study, the MSIS data was searched for other incidents within 2 years of the vessel loss.

The table shows 95 prior incidents. These incidents involved 87 of the vessels in this study, or just under 10% of the total. Only 13 vessels had multiple incidents, 2 vessels had 3 prior incidents and 10 vessels reported 2 prior incidents. This is a relatively small number of occurrences which are spread across 11 different accidents types. As such, the data are considered inconclusive. A study of casualties in the First Coast Guard District by the Volpe Transportation Systems Center also found prior incident data to be sparse.

> *"Data on previous accident and failure history are certainly an indicator in some cases for risk of serious accidents, but are not sufficient across the case population to make an analytical conclusion."*[8]

F/V Incidents Within 2 Yrs of Total loss.	
Type	No. Incidents
Loss of Vessel Control	31
Flooding	25
Accidental Grounding	13
Collision	6
Allision	5
Fire	5
Loss of Electrical Power	4
Sinking	3
Abandonment	1
Capsizing	1
Structural Failure	1
Grand Total	**95**

Table 6

[8] Marine Technology, Vol. 37, No 1, *Hazard and Risk in the New England Fishing Fleet*, Page 47.

Accident Prevention

Up to this point, the casualty data has been examined by vessel characteristics, operations and cause. Factors that appear significant in the loss of fishing vessels were identified, but would losses decrease if all vessels complied with the safety regulations?

It is important to note that the Federal Regulations promulgated under the 1988 Fishing Vessel Safety Act (46 CFR, Part 28) primarily focus on lifesaving and firefighting equipment. For a limited number of vessels, there are additional requirements for navigation equipment, machinery safeguards, and stability tests. However, it would be difficult to show that strict compliance with the fishing vessel safety regulations would prevent vessel losses. Further, the data presented on the preceding pages shows that most losses are due to navigation or seamanship errors, or hull and machinery problems - problems that are largely not covered in the regulations.

Voluntary dockside exams

The Coast Guard's voluntary dockside examination program includes an outreach component, intended to raise awareness of vessel integrity, stability, and maintenance problems that often lead to vessel loss. This is a possible benefit of dockside examinations that is not included in law or regulation. Of course, the voluntary nature of the program suggests a self-selection bias. In other words, the exams are not focused on vessels that need the most safety improvements, nor are the exams randomly distributed throughout the fishing fleet. Instead, vessel owners and operators that are already interested in safety improvement will request the exam. Further, it has been estimated that only 6% of the fishing fleet receives the exam in any given year, and some of the exams are repeat visits, to "renew" the Coast Guard safety decal. In fact, the MSIS data shows only about 9,000 vessels ever had a safety decal, which is less than 10% of the fishing fleet.

Do voluntary exams help?

Table 7 summarizes the decal status of the lost fishing vessels. Current decals, issued within the prior 2 years, were onboard 18% of all lost vessels, and 21% of the documented vessels. With such a high percentage, it does not appear that dockside exams helped prevent vessel loss. In fact, other studies have concluded that additional measures are needed to prevent vessel loss, including crew training and licensing and requirements for design, watertight integrity, stability and periodic inspections of fishing vessels. The *Fishing Vessel Casualty Task Force Report*[9] covered this topic in detail.

Decal Status	Vessels Lost	Documented Only
None	652	494
Current	165	153
Expired	86	78
Unknown	4	1
Grand Total	907	726

Table 7

[9] U. S. Coast Guard. *Living to Fish, Dying To Fish*. Fishing Vessel Casualty Task Force Report, Washington, DC, March, 1999, Chapter 5 and Appendix E.

Trends In Vessel Loss

Figure 12, which shows vessel losses by calendar year, indicates a relatively sharp drop in year 2000 to the lowest point in 7 years. Did something change to reduce the casualty rate? The reduction might be explained by increased emphasis on fishing vessel safety after the 1999 Task Force report was released. Here are some highlights:

1999 Coast Guard Atlantic and Pacific Area Initiatives.

- On April 28, 1999 the Assistant Commandant for Operations and the Assistant Commandant for Marine Safety & Environmental Protection, after consultation with the Commercial Fishing Vessel Advisory Committee, released an official message describing a series of short term and long-term actions to enhance safety. Based on the Task Force report, the short-term actions included increased emphasis on safety items during at-sea boardings, additional training for boarding officers and stepped up outreach activities.
- During the fall and winter of 1999, each of the Coast Guard Area Commanders announced their own initiatives to reduce fishing vessel casualties – "Operation Safe Catch" in Atlantic Area and "Operation Safe Return" in the Pacific Area. As suggested in the Commandant's message, these initiatives placed additional emphasis on safety items during at-sea boardings.
- There was also a sharp increase in the number of dockside exams as indicated by the upper line on Figure 12.

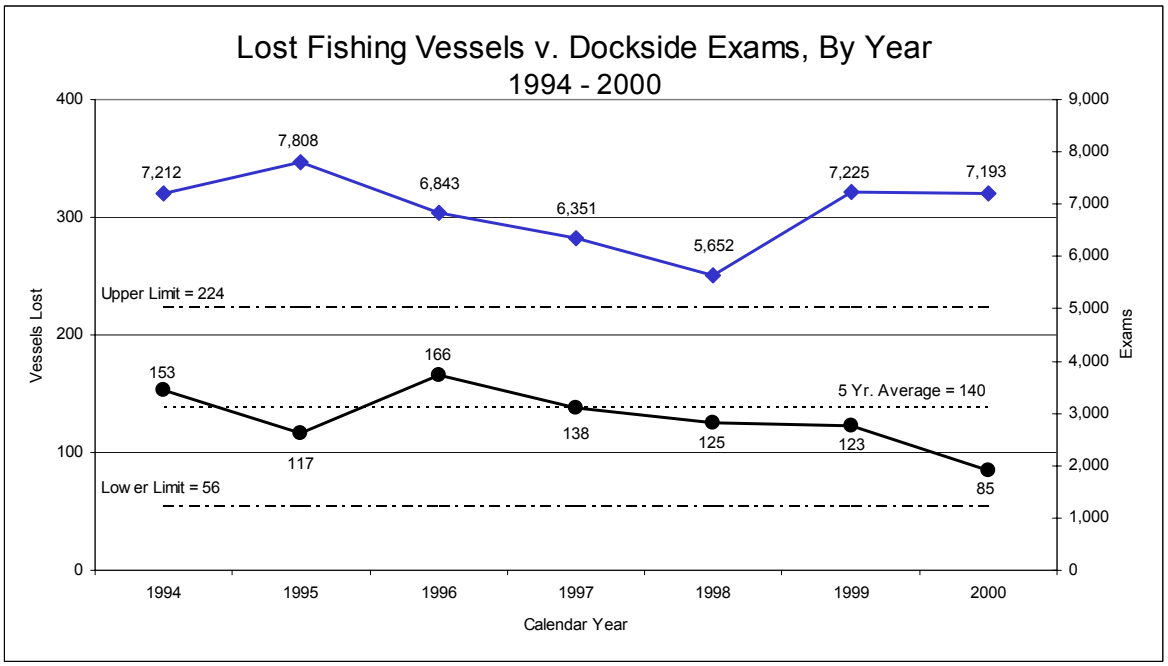

Figure 12

The combination of underway and dockside initiatives just described appears to be a short-term reduction in vessel losses.[10]

Process control chart analysis.

A methodology, known as control charting, can be used to further evaluate the recent drop in vessel losses. Control charts are a simple means to examine trends across different points in time.[11] Thus, upper and lower control limits have been added to Figure 12 to show the normal range of variation in fishing vessel losses. Values that cross above or below the limits are considered "out of control" meaning they are significant and could signal the success or failure of safety initiatives. The control limits for this chart are based on 1994 – 1998 values, (i.e., the "baseline").

The chart shows vessel losses for calendar year 2000 approaching the lower limit. If the downward trend continues below the lower limit, the reduction in vessel losses would be considered statistically significant. If the trend returns to prior levels, an average of approximately 129 vessel losses per year can be expected. Actual counts can be expected to fluctuate between the limits shown.

[10] Not shown on Figure 12 are the numbers of underway boardings. A representative of the Operations Directorate advised that F/V boarding was significantly under-reported and is considered unreliable. A new information system, Marine Information for Safety and Law Enforcement, was activated in December 2001 and promises to provide very useful data in this area.

[11] Wheeler, Donald J., *Understanding Variation: The Key to Managing Chaos,* SPC Press, Inc., Knoxville, TN, 1993, pg. 134. Mr. Wheeler's methodology for developing control charts is summarized as follows:

- Use the average of the individual observations (**X**), for the central line.
- Calculate the average moving range, (m**R**). This is done by finding the difference in the individual observations, the moving ranges, (e.g., the difference between the 1994 losses and the 1995 losses is 36), then averaging the moving ranges.
- Calculate the upper control limit, (UCL). UCL = **X** + (2.66 x m**R**).
- Calculate the lower control limit, (LCL). LCL = **X** - (2.66 x m**R**).
- Display the individual values, the central line, the upper control limit, and the lower control limit on a line chart.
- The trend line of the individual observations is interpreted by comparing them to the upper and lower control limits. Values that cross one of the limits are considered "out of control." In other words, the change cannot be explained by normal variation.

Data Interpretation/ Conclusions

On the preceding pages, various aspects of fishing vessel losses were examined. The findings and conclusions are summarized as follows:

- **Vessel Population** - The U.S. fishing fleet is a combination of vessels that are either state numbered or documented by the Coast Guard. With records distributed among so many jurisdictions, it is difficult to get good population data for the entire fleet. It has been estimated that the smaller, state numbered vessels are 65% - 75% of the fleet.[12] The Coast Guard issued documents to just over 80% of the lost vessels. Population data for documented vessels is readily available as part of MSIS. Thus, accident rates for that group of vessels were studied separately.

- **Accident Rates of Documented Vessels** - The "normalized" data (i.e., accidents per 1000 vessels), for documented fishing vessels showed the following:
  - Accident rates increased with vessel length. A sharp spike in the data occurred for vessels between 60 and 70 feet.
  - Accident rates increased with vessel age.
  - Of three primary materials used for construction, wood vessels are lost most frequently, followed by steel. At first, the loss rate for steel vessels appears contradictory, because there are twice as many fiberglass vessels. However, the fiberglass vessels are shorter. Also, the percentage of steel vessels over 30 years was higher.

- **Vessel Operation** - After looking at <u>which</u> fishing vessels were being lost, MSIS casualty data was used to examine <u>how</u> the losses occurred. Using all 907 lost vessels, the losses were grouped by operation. Nearly half of all vessel losses (46%) resulted from underway and maneuvering operations. Conversely, only 18% of all lost vessels could be attributed to actual fishing activities. ***This indicates that fishing activities and type of gear are not primary factors in most accidents.***

- **Cause of the Casualty** - Next, only the vessels lost while underway and maneuvering, which accounted for nearly half of all vessel losses, were examined by cause of the casualty. The primary causes were in two areas: navigation/seamanship (33%) and structural/machinery failures (52%). ***Again, factors related to fishing operations did not appear to be significant.***

  For the vessels that <u>were</u> lost during fishing operations, three primary causes were noted: structural/machinery failures (60%), capsizing (24%), and

[12] For example, the National Marine Fisheries service estimated that 66% of the fishing fleet was state numbered for 2000. However, the numbers for several states, including Texas and North Carolina were not available. National Marine Fisheries Service, *Fisheries Of The United States*, Silver Spring, MD, April 2001.

navigation/seamanship (18%). With a few exceptions, the capsized vessels can be attributed to stability problems from the shifting of cargo, overloading, and to catching of fishing gear on obstructions.

This causal information indicates the following:

Overall, the biggest cause of vessel loss is structural and machinery failure, during both underway and fishing operations. Such failures result in flooding, loss of propulsion, fires and explosions. These casualties are not considered directly related to the business of fishing, but to things that will occur on any type of vessel and are largely not addressed in the current fishing vessel safety regulations.

The second largest factor in underway vessel losses is navigation and seamanship errors, which result in allisions, collisions and groundings. These casualties are the results of not maintaining a proper lookout (i.e., falling asleep at the wheel or inattention), vessel handling, and navigation errors. Such casualties may be reduced, in part, by additional training of fishing vessel operators. However, the data showed a large human factors component as well – fatigue (31 of 138 cases).

The most apparent fishing-specific factor is capsizing. Shifting cargo, overloading, or catching of gear on submerged obstructions were reported for 23 of 33 capsized vessels.

- **Recent Trends –** There was a notable reduction in vessel losses for calendar year 2000. This occurred shortly after stepped up outreach and enforcement activities, which may have produced a short-term safety improvement. The use of a control chart showed that the drop in vessel losses is approaching the point of statistical significance.

E. DEATHS AND MISSING PERSONS

Overview

As noted, the fishing vessel casualty data for calendar years 1994 - 2000 included 344 reports involving loss of life. Those 344 incidents resulted in 466 deaths or missing persons, and included 119 of the lost vessels described in the preceding section of this report. This section will focus on those deaths and missing persons.

Descriptive Statistics

There are many possible ways to look at the casualty data. Rather than start with a specific question or theory, the intent of this review was to first look for the most common or significant factors in how lives were lost. Thus, tabular and graphical summaries are used as a starting point, followed by more detailed examination, where appropriate.

The histogram in Figure 13 summarizes the number of fatalities per incident. Together, incidents with either one or two fatalities are 92% of the cases and 79% of the deaths.

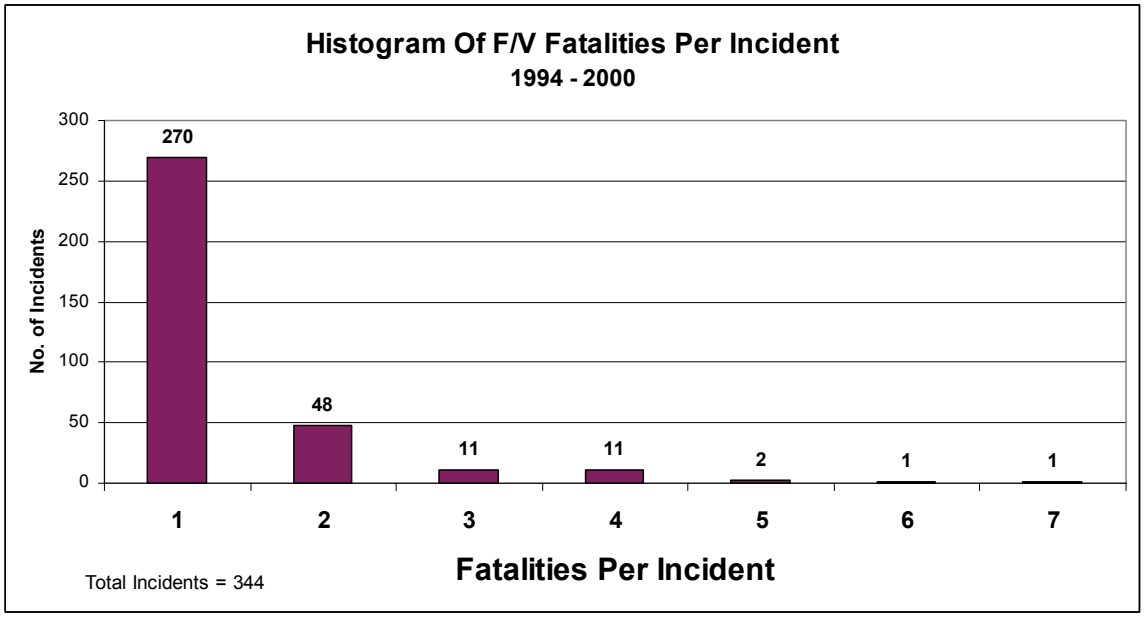

Figure 13

One item in the database describes, very generally, the nature of personnel casualties. This is summarized in Figure 14. One can see that the top three values account for 87% of the personnel casualties (407 of 466). ***This suggests that nearly 9 of 10 times a person dies because they entered the water***. Since this appears to be a very significant factor, other items in the database were examined to confirm this.

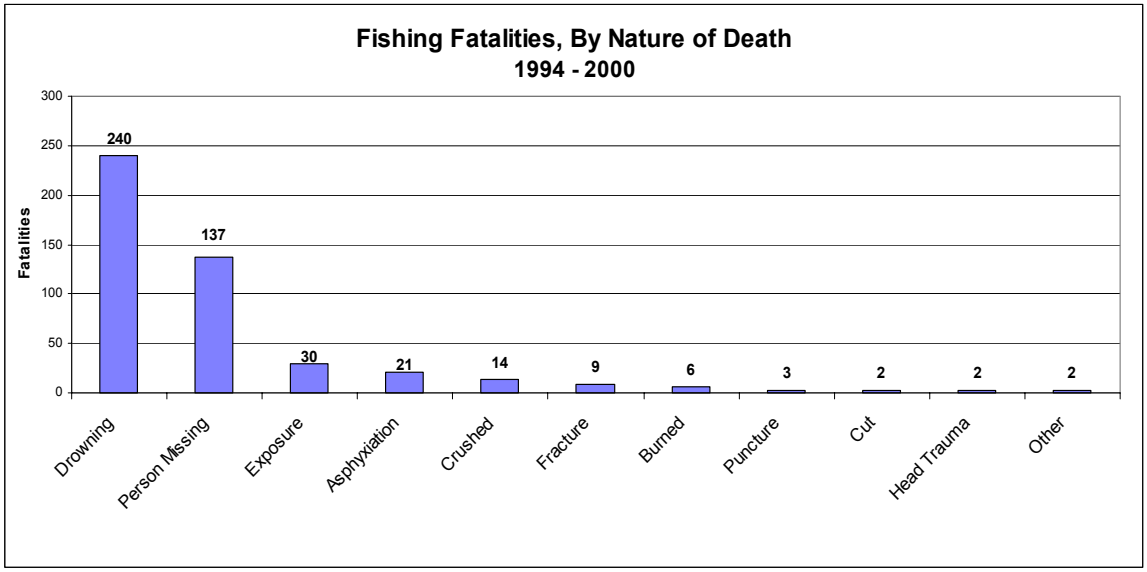

Figure 14

Deaths By Casualty Event

To further explore the idea that fishermen die most from water exposure, the case information was summarized by the first event in the casualty as shown in the Table 8. There can be numerous events in an incident. For example, a vessel might experience a fire, then flood and sink, resulting in a death by drowning. In this scenario, the casualty would be counted as a fire since it was the first event that set off the sequence of events resulting in a personnel casualty.

First Casualty Event	Sum Of Dead/Missing
Vsl. Flooding/sinking/capsize	218
Fell overboard	119
Diving accident	22
Hypothermia	19
Pulled overboard by gear	16
Hazardous material exposure	11
Fire, smoke	10
Caught in winch	8
Crushed by gear	8
Head trauma	6
Unknown	11
Struck by line, fractures	5
Struck by gear, fractures	4
Caught in lines	3
Operating machinery	2
Bumped object	1
Confined space entry	1
Drowned while attempting to cut line from propeller	1
Electrical shock	1
Grand Total	**466**

Table 8

From Table 8 and Figure 15, nearly half (48%) of all F/V deaths are attributed to flooding, sinking, or capsizing of the vessel. Another 25% of the fatalities were falls overboard. ***With nearly three-quarters (72%) of all fatalities, water exposure is by far the most significant factor in personnel loss***. The next highest category, deaths from being struck by or caught in moving equipment (10%), is greatly overshadowed by the water exposure deaths.

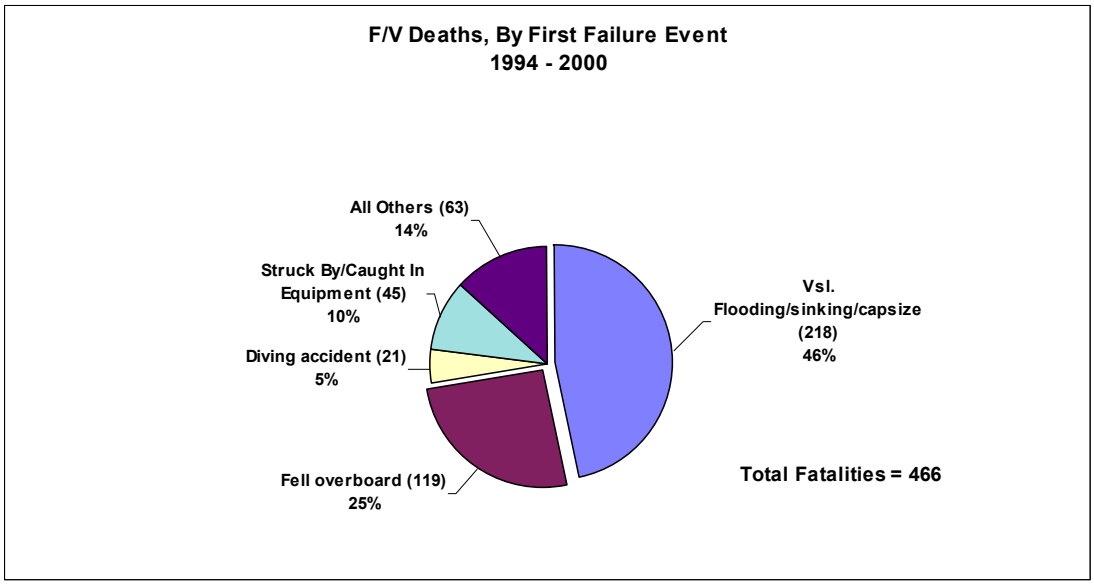

Figure 15

Deaths With Vessel Loss

Since the largest group of all personnel casualties is associated with the loss of a vessel (218 of 466), it is useful to look at them separately. Figure 16 shows this group arranged by Coast Guard District. (The arrangement of Coast Guard Districts is shown on Figure 17.) The three highest fatality counts are along the West coast of the U.S., accounting for over half (58%) of the vessel-related deaths. In fact, the next two Districts are adjacent to one another on the Mid-Atlantic/New England Coast (23%), followed by Gulf of Mexico and the Southeast U.S. (16%).

The arrangement of fatality counts along the U.S. coastline seems even more significant when one looks at the figures for the 8th Coast Guard District along the Gulf of Mexico. Overall, the 8th District had the second highest number of fatalities, behind the 17th District (Alaska), as shown previously on Table 2. The counts were 82 and 97, respectively. Conversely, there were much fewer vessel-related fatalities in the warmer Gulf of Mexico waters. This suggests that the large percentage of casualties on the West Coast can be attributed to cold-water exposure (e.g., the Aleutian, California, and Davidson currents which are close to shore and extend the length of the West Coast) and more severe sea conditions (e.g. hazardous bar crossings). Thus, as expected, the availability and use of survival equipment becomes more critical as environmental conditions become harsher.

Incidents With Vessel Loss and Fatalities.

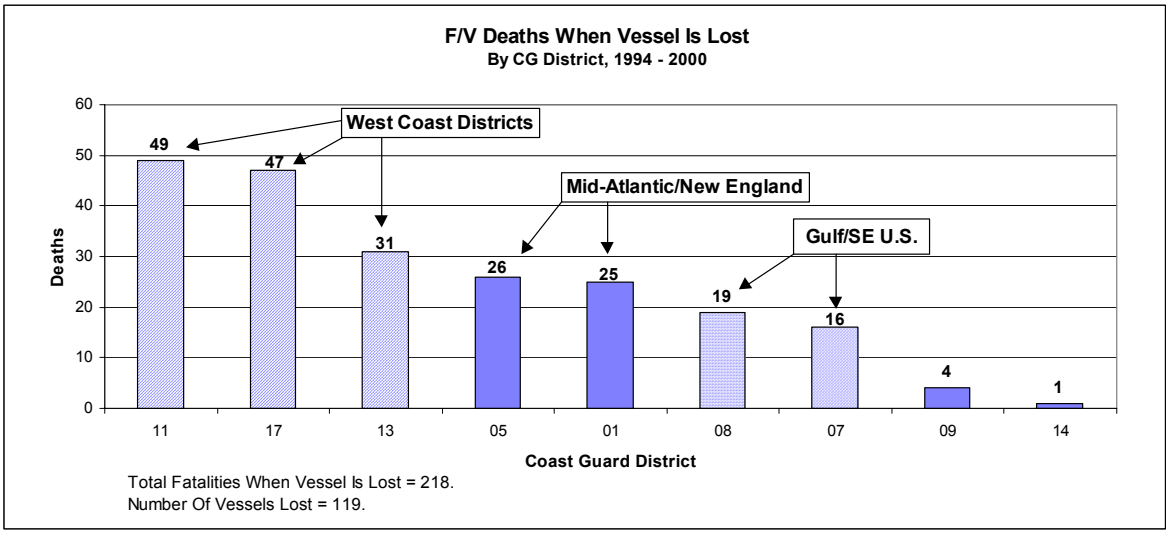

Figure 16


U. S. DEPARTMENT OF TRANSPORTATION
Nine Districts
U.S. COAST GUARD AREAS AND DISTRICTS
DISTRICT 17
Alaska
Juneau
DISTRICT 14
Honolulu
Hawaii
DISTRICT 13
OREG.
WASH.
Seattle
MONT.
ID.
DISTRICT 11
CALIF.
NEV.
UTAH
ARIZ.
Alameda
COLO.
WYO.
N. MEX.
DISTRICT 8
N. DAK.
S. DAK.
NEBR.
KANSAS
OKLA.
TEX.
MINN.
IOWA
MO.
ARK.
LA.
WIS.
ILL.
MICH.
IND.
OHIO
KY.
TENN.
MISS.
ALA.
GA.
FLA.
New Orleans
DISTRICT 9
Cleveland
N.Y.
PA.
W VA.
VA.
N.C.
S.C.
DISTRICT 7
Miami
DISTRICT 1
ME.
VT.
N.H.
Boston
MASS
R.I.
CONN.
N.J.
DEL.
MD.
Portsmouth
DISTRICT 5
Legend
Washington, D.C. Headquarters
District Offices
Area and District Offices

Figure 17

West Coast Fatalities

As shown in Figure 16, most fatalities associated with a vessel loss (58%) occurred in waters off the U. S. West Coast as fishermen are exposed to more severe conditions. What about the time of year? The 127 West Coast fatalities are shown on Figure 18 by month. There is a dramatic difference between the months of October through January and the rest of the year, by two to three times. This high fatality rate may be an indicator of more severe conditions during winter months, OR, a connection to the dates of the various fishing seasons. For example, the Alaska crab season occurs each year during the winter months. Fishery data, which was not readily available for this report, may be available to further explain this trend. In either case, the combination of location and time of year show a significantly increased fatality rate.

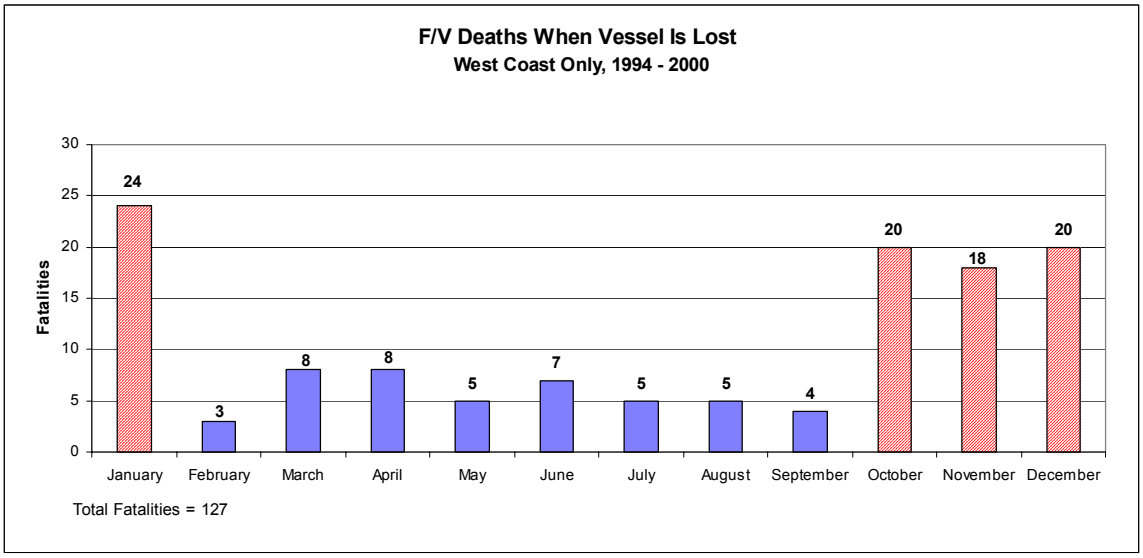

Figure 18

Use Of Safety Equipment

The casualty data presented in Figure 18 shows that 9 of 10 fatalities result from water exposure. The 1988 Commercial Fishing Industry Safety Act and associated Federal Regulations address water exposure fatalities through emergency equipment and procedural requirements. Thus, one would expect a reduction in fatalities among the fishing vessels that have on board and use the required emergency equipment. According to the 1999 Task Force report, there was some apparent improvement. During the five years prior to the Fishing Vessel Safety Act, 1984 through 1988, there were 519 fatalities. For a comparable period ten years later, from 1994 through 1998, there were 357 fatalities – 31% lower.[13] Overall, this suggests that the change in safety requirements had the intended effect.[14]

[13] *Living to Fish,* Chapter 4, Page 14.

[14] Again, these figures are not "normalized" or referenced to the number of persons working on fishing vessels or other factors such as weather, fishing activity or economic factors. Thus, the population is assumed to be constant throughout the period. Indeed, there would have to be a dramatic change in the worker population to negate the 31% reduction in fatalities.

From the 1994 through 2000 casualty data, the two primary events leading to water exposure fatalities were vessel loss and falling overboard. Of the 218 fatalities resulting from vessel loss, the usage rates of survival equipment, shown in Table 9, were very low. For PFDs (Personal Flotation Devices)/Survival Suits, rescue boats and EPIRB's, the usage rates were 18%, 16%, and 24%, respectively. The use of radios, more commonly available for business purposes, was reported in 43% of the incidents. Thus, it is reasonable to assume that many of these fatalities were preventable with use of the required emergency equipment. It is notable, however, that 61 of the 218 fatalities, or 28%, showed "available, no time for use" for PFD/Survival Suit utilization. Generally, these fatalities occurred when the vessel was lost suddenly, such as capsizings, or when a problem, such as engine room flooding, was not discovered in a timely manner. Because of the high number of fatalities, a separate review of those cases would be appropriate.

	Used (%Used)	Not Used	Not Applicable[15]
PFD/Survival Suit	40 (18%)	173	5
Rescue Boat	35 (16%)	174	9
EPIRB	52 (24%)	158	8
Radio	93 (43%)	125	--

Table 9

Voluntary Dockside Examinations

Data from the Coast Guard's voluntary dockside exam program provides another indicator of safety. Since the program began in 1992, exam results were recorded in the MSIS database. Also, vessels meeting all safety requirements were issued decals to display onboard. Of the 218 fatalities resulting from a vessel loss, 71% occurred on vessels with no decal or with a decal over 2 years old (unofficially "expired") as summarized in Table 10. This is an indication that safety equipment, and the increased awareness gained through interaction with crewmembers during dockside exams, is saving lives. However, it is understandable that 62 fatalities occurred on vessels with decals. A review of the investigation reports showed that this group of vessel losses occurred suddenly, with little time to respond. The fatalities occurred on 24 vessels that were lost by capsizing (13), flooding (5), collision (3), sinking (2), and grounding followed by breakup (1). In these casualties crewmembers were unable to use survival equipment or, in a few cases, could not fully don a survival suit before entering the water.

[15] The "Not Applicable" values represent incidents where survivors were able to step directly onto another vessel without first entering the water.

Deaths When Vessel Is Lost	
Decal Status	**Dead/Missing**
None	135
Current	62
Expired	19
Unknown	2
Total	**218**

Table 10

Survival Rates

A survival rate can be calculated by comparing the number of persons on lost fishing vessels to the number of survivors. From Figure 16, we know the greatest number of deaths occurred along the United States West Coast, apparently because of more severe water conditions (127 deaths involving the loss of 66 vessels). Because of the more severe conditions, we also know that the use of lifesaving equipment is more crucial along the West Coast. Thus, survival rates were prepared for the vessel-related fatalities in West Coast waters as shown on Table 11.

Even with incomplete data, the results indicate that ***fishermen survive nearly twice as often when survival equipment is used***. In fact, the survival rate for cases when exposure suits are reported as "Used" should be higher. Because of how the database was constructed, "Used" was reported for the incident overall rather than for each person. In a number of individual cases, some crewmembers used exposure suits and lived while other crewmembers did not use exposure suits and died or were missing. This would be classed as a case where survival equipment was used. "Not used" was shown in the data when no one used the equipment. Thus, if counted by person, instead of incident, the persons at risk under "Used" would be lower and the "Not Used" values would be higher.

This is considered to be a very significant finding.

SURVIVAL RATE COMPARISON			
West Coast of the U.S., 1994 - 2000			
Survival Suit Usage	**Persons At Risk**	**Survivors**	**Survival Rate**
Used	45	25	55.5%
Not Used	102	25	24.5%
Unknown	42	12	N.A.

SURVIVAL RATE COMPARISON			
West Coast of the U.S., 1994 - 2000			
Lifeboat/Raft Usage	**Persons At Risk**	**Survivors**	**Survival Rate**
Used	45	21	46.6%
Not Used	87	21	24.1%
Not Applicable	3	2	N.A
Unknown	54	18	N.A.

Table 11

Good Samaritan Rescues

As the casualty data was being prepared for this study, it appeared that crewmembers were often rescued by nearby vessels. However, this information was not directly captured in the MSIS database in a way that could be electronically searched and analyzed. Therefore, the narrative information in each case report was read to determine how often crewmembers were rescued by Good Samaritans.

The case reports showed that Good Samaritan vessels rescued one or more crewmembers in 253 of the 907 vessel losses, or 28% of all incidents. The distribution of these cases, by Coast Guard District, is proportional to and parallels the overall vessel losses very closely, as shown in Figure 19.

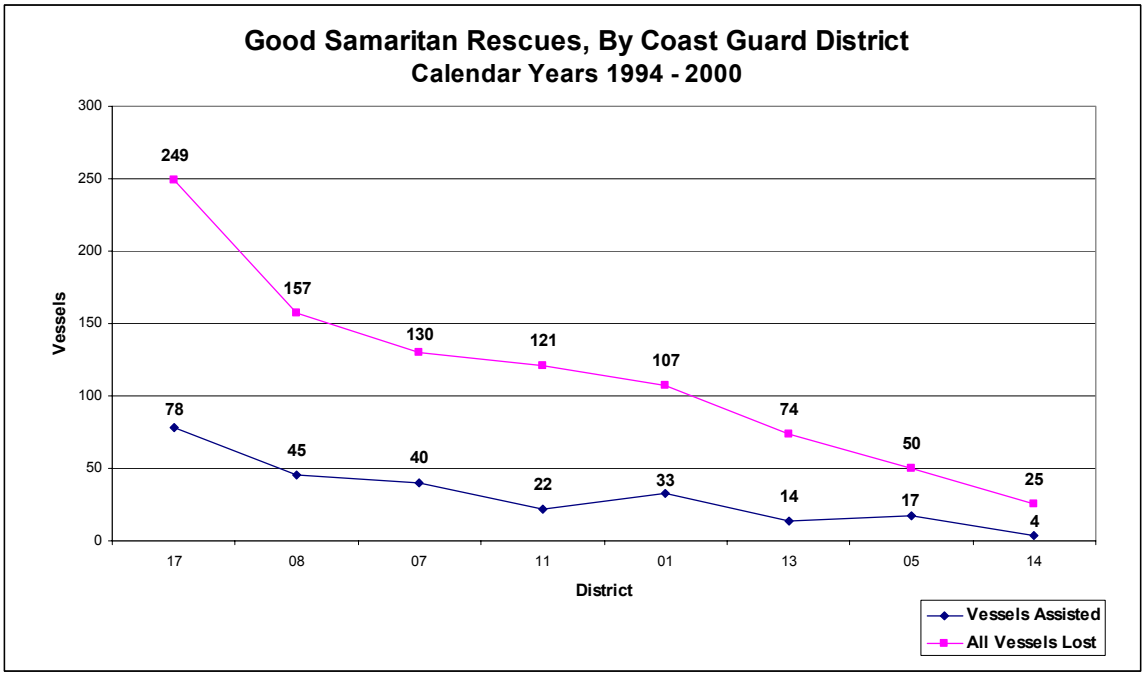

Figure 19

The significance of Good Samaritan rescues becomes apparent when compared to vessels where no assistance was available, as summarized on Table 13.

Of the 253 vessels that received Good Samaritan assistance, only 14 of them resulted in one or more fatalities for a total of 18 persons (.72 fatalities per vessel). Conversely, there were 105 vessels lost with fatalities but no assistance. Those incidents resulted in 200 fatalities, or 1.9 fatalities per vessel.

	Lost Vessels With Good Samaritan Assistance	Lost Vessels With Fatalities, But No Assistance	All Lost Vessels With Fatalities
Vessels	253	105	119
Persons At Risk	770	301	346
Fatalities	18	200	218
Fatalities/Vessel Lost	**.72**	**1.90**	**1.83**

Table 13

Of the 14 vessels with fatalities during Good Samaritan assistance, the case reports showed that the vessels were lost suddenly due to flooding or capsizing. However, there was at least one survivor in each of these incidents making it possible to get some details about the deaths.

Of the 18 fatalities in this group, six persons died when they were either trapped inside their vessel or were entangled in fishing gear. Eight persons died after entering the water, with no time to don a survival suit or PFD, (i.e., the vessel went down quickly). Three more persons died in survival suits that were not fully closed. Finally, a vessel's master died after he remained onboard and attempted to save his vessel. In each of these incidents, crewmembers entered the water before arrival of the Good Samaritan vessel.

As noted, lifesaving equipment was the critical factor in 11 of the 18 fatalities. Thus, it is concluded that:

- ***Even when a Good Samaritan vessel is nearby, lifesaving equipment is essential.***
- ***A significant, but unknown, number of crewmember fatalities were prevented, especially in the cold west coast waters, where Good Samaritan vessels were present for nearly 3 of every 10 vessels that were lost. Hypothetically, 454 lives may have been saved if one assumes the same rate as the vessels with no Good Samaritan assistance:***

  200 deaths/105 incidents = 1.9 deaths per incident.
  1.9 x 239 assisted vessels with no fatalities = 454 fatalities prevented.

Accident Trends

Trend lines for vessel losses and fatalities are shown together in Figure 20. For both trends, the calendar year 2000 values are the lowest in the 7-year period. Again, it appears that the increased outreach and enforcement activities following the 1999 fishing vessel task force may have contributed to a short-term reduction in vessel loss and fatalities[16]. It is too soon to tell if this trend will continue. However, it appears that the vessel loss and fatality values tend to increase and decrease together. To confirm this relationship, the values can be compared to one another with a scatter plot and shown as a correlation.

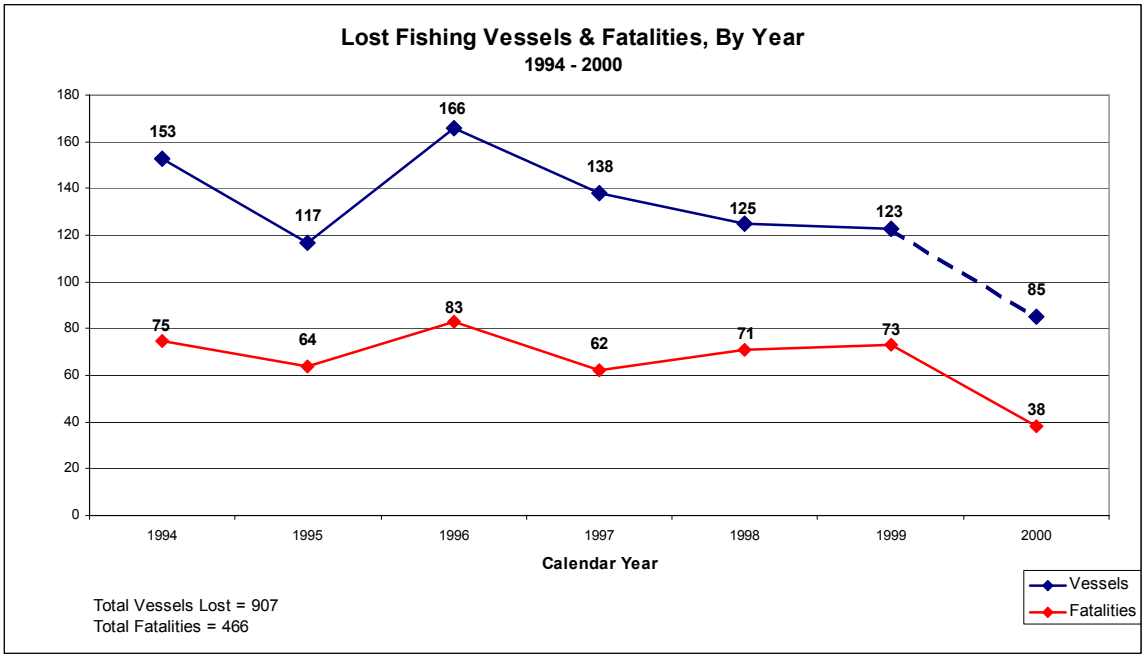

Figure 20

Figure 21 shows a strong correlation between vessel loss and fatalities. Statistically, 77% of the variation in fatalities can be explained by vessel losses. This is known as the "coefficient of determination."[17] The best-fit regression line was added to the graph to show where the values would fall if the relationship were perfect, (i.e., 100%). Also, the regression line shows that, fatalities consistently occur at the rate of one fatality for every two vessels lost. This strong relationship suggests that vessel losses must be reduced in order to further reduce fatalities.

[16] Earlier, a control chart showed that the drop in vessel losses was approaching the point of statistical significance. A chart was prepared for fatalities, which generated comparable results, and is, thus not shown herein.

[17] Bluman, Alan G., *Elementary Statistics, A Step By Step Approach,* McGraw – Hill, 2001, 4th Edition, pg 492.

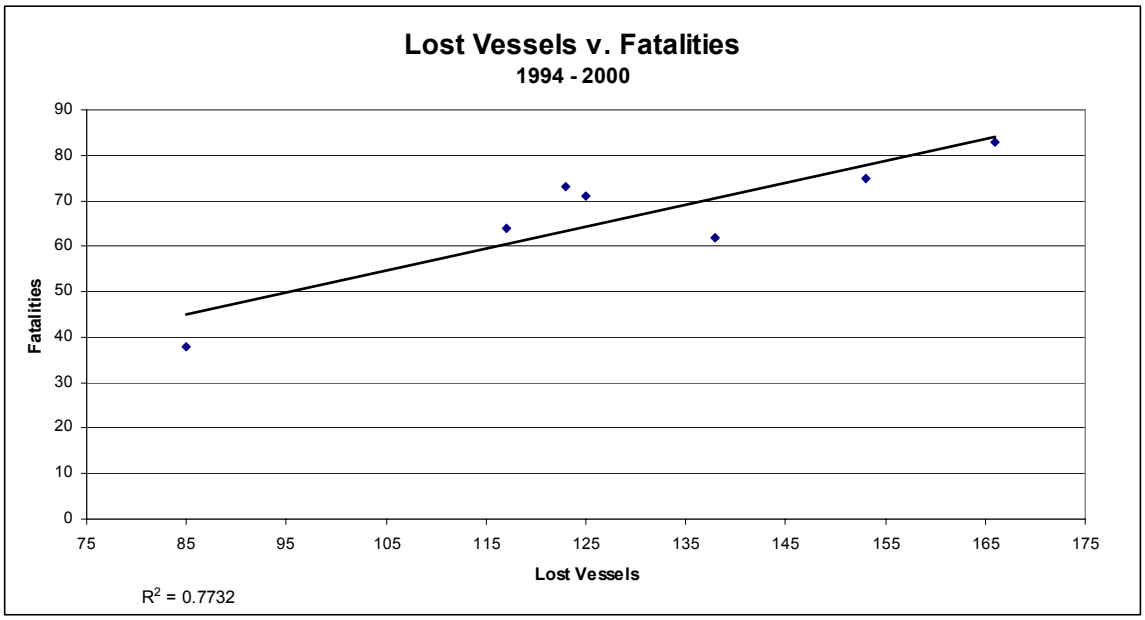

Figure 21

Data Interpretation

In this section, the most important factors leading to loss of life on fishing vessels were sought. The findings and conclusions are as follows:

- **Nature of Death** - A summarization of fishing vessel deaths by the manner in which the person died showed that the person entered the water in 87% of the cases (407 of 466).

- **First Casualty Event** - When the cases were grouped by the first casualty event, water exposure was confirmed as the most prevalent factor in fishermen deaths. Falls overboard, vessel floodings, sinkings, and capsizings accounted for 72% of the deaths and missing persons. Predominately (in 46% of fatalities overall), the data indicates that fishermen are dying from water exposure as a result of vessel loss (i.e., foundering and sinking). Conversely, deaths from actual fishing operations were only 10% of the overall total.

- **Deaths From Vessel Loss, By District** – For this sub-group of fatalities, loss of life was dramatically higher on the U. S. West Coast than in any other region (58% of the total). A most likely reason for this is year-round cold water close to the coastline (Aleutian, California, and Davidson currents). Also, fatalities were dramatically higher, by at least double, during the months of October through January. While there may be a number of seasonality variables, it is known that Alaska crabbing occurs in the same timeframe.

- **Use of Lifesaving Equipment** – For fatalities related to vessel loss, the use of lifesaving equipment was very low. Also, for the West Coast incidents, survival rates were calculated based on lifesaving equipment usage. The data showed survival rates doubled when the equipment was used, even though data about lifesaving equipment usage was not always provided in MSIS. Finally, it was shown that, in the West Coast cases, only 28% of the vessels involved had a safety decal. When fatalities occurred on vessels with decals, the vessels were lost suddenly, with little or no time to respond. In those casualties crewmembers were unable to use survival equipment or, in a few cases, could not fully don a survival suit.

- **Good Samaritan Rescues** – When fishing vessels were lost, good Samaritan vessels were frequently on hand to rescue crewmembers (over 28% of the incidents). There were very few fatalities during such incidents, and when fatalities did occur, the vessels were lost quickly due to flooding or capsizing. Further, the small number of fatalities showed that lifesaving equipment is important, even when help is nearby. It was concluded that ***fatalities would have been significantly higher without the assistance from Good Samaritan vessels. Hypothetically, as many as 454 deaths may have been prevented.***

- **Accident Trends** – Both vessel losses and fatalities dropped sharply in calendar year 2000 to the lowest level in 7 years. It is believed that the short-term reduction in fatalities and vessel losses were due, at least in part, to the increased emphasis on fishing vessel safety after the 1999 Task Force. Also, there was a high correlation between vessel loss and fatalities. Throughout the 7 year period, fatalities occurred consistently at the rate of one for every two vessels lost.

The above findings indicate the following:

- ***Factors leading to vessel loss will have to be addressed in order to further reduce fatalities below current levels, especially for incidents that occur suddenly, such as capsizing.***
- ***Some deaths can be avoided when lifesaving equipment is available and properly used, as required by the existing regulations in Title 46 of the Code of Federal Regulations***.

APPENDIX: SELECTED CASUALTIES FOR 2000

Described below is a sampling of fishing vessel casualties that occurred during calendar year 2000.

Poor maintenance and outdated lifesaving equipment

June 6, 2000 – While returning from a 3-day fishing trip, the *INFINITY* began taking on water and sank quickly by the stern. The vessel was lost approximately 17 miles southeast of Cape Elizabeth, along the coast of Maine. One of the three crewmembers was rescued and the other two were recovered deceased. Among the many findings, the investigating officer's report included the following:

- An inexperienced helmsman did not notice the vessel losing freeboard by the stern. When the flooding was discovered by another crewmember, the vessel's stern was nearly under water.
- Water entered the vessels aft compartment through a leaking rudder post. There was no functioning bilge pump in that space.
- All of the crewmembers donned survival suits. However, all of the suits were well beyond their service lives. Significant amounts of water were found in the suits of the two deceased crewmen, because they did not fit properly. One of the two suits was too small. A zipper jammed on the other.
- The vessel's liferaft did not release.
- The vessel's EPIRB floated free, functioned properly and facilitated a quick rescue and recovery by Coast Guard aircraft.

An unsafe practice results in a missing crewmember

October 24, 2000 - The F/V *LIMIT STALKER* was fishing approximately 30 nautical miles west-southwest of Cape Alava off the Washington Coast. The vessel was rigged with mid-water trawl gear and targeting Brown Rock Cod. At approximately 2055 (local) the vessel had completed a trawl and had hauled back its net which contained a load of Green Rock Cod. The vessel had already obtained its quota of Green Rock Cod and could not retain the catch. Not wanting to dump the catch on deck, a crewman leaned outboard the vessel while standing on top the net and attempted to open the "cod-end." He subsequently lost his footing and fell into the water, with no lifejacket or safety harness. An attempt to reach the crewman in the water with a life ring failed and the operator immediately brought the vessel about. Two subsequent attempts with the life ring failed and the crewman was observed to sink beneath the surface of the water just off the starboard outrigger of the vessel. Two fishing vessels and two Coast Guard helicopters responded to search but were unable to locate the crewman. He remains missing and is presumed drowned.

Effective use of lifesaving equipment and a Good Samaritan Rescue	April 20, 2000 – The F/V *DESTINY* reported that they were returning from fishing the opilio crab season in the Bearing Sea when they began taking on water in the Shelikof Strait. After working to slow the flooding briefly, it became evident the vessel would sink. The crew abandoned their vessel in survival suits and entered a liferaft. After hearing an emergency broadcast from the Coast Guard Air Station Kodiak, the fishing vessel *POLAR STAR* responded and pulled all members from the raft uninjured. The *POLAR STAR* crew saw the vessel submerge in 112 fathoms of water and transported the survivors to Kodiak.
Fatality while fishing alone	May 29, 2000 - The *SEA MISER* was found aground in the Copper River Delta area of Alaska by the operator of the *PROSPERITY*. The *SEA MISER*'s sole occupant was found out of the vessel, entangled in the gillnet. Also entangled in the net was a gaff hook, and a large (40-50 lb) chinook salmon. The vessel's engine was still running at idle speed with the engine out of gear. The deceased was believed to have either been pulled overboard or have fallen overboard while attempting to gaff the chinook salmon, became entangled in the gillnet, and subsequently drowned. The fishing vessel eventually either drifted ashore or grounded during a tidal change.
Grounding and total loss of a vessel due to operator fatigue	August 19, 2000 – The *PILIKIA* ran aground in Northwest Harbor, San Clemente Island California. Hull damage resulted in flooding and, subsequently, to total loss of the vessel. The operator, who admitted to falling asleep at the wheel, had only three hours of sleep in the preceeding 24 hour period.
EPIRB results in quick rescue	July 22, 2000 – While returning from a successful fishing trip, the operator, and sole person onboard the *CHANNEL SURFER* discovered smoke coming from the vessel's engine room. The operator opened a hatch to the engine room to investigate, which was immediately followed by a small explosion. At that point, he evacuated the vessel to an inflatable life raft and activated an EPIRB. A helicopter was immediately launched from Coast Guard Air Station Kodiak, AK, and recovered the survivor.
Overloading causes vessel to capsize, trapping master onboard	September 30, 2000 – The *SEAWOLF* capsized, during stormy weather in the Gulf of Mexico, trapping the vessel's master in the pilot house, where he drowned. The only other crewmember onboard entered the water and clung to the capsized vessel. When the crewmember discovered that the vessel's EPIRB did not release, he swam under the vessel and released it manually. The crewman was rescued approximately 2 – ½ hours after the EPIRB signal was received. Later the same day, the master's body, which was entangled in wiring and debris, was recovered by divers. The Coast Guard investigating officer concluded that overloading was a contributing factor in this incident.
Master and mate drown while trying to save their vessel	October 7, 2000 – While heading to fishing grounds off the coast of Virginia, flooding was discovered in the engine room of the *CAROLINA BREEZE*. Attempts to dewater the vessel with onboard pumps and pumps supplied by Coast Guard helicopters were not successful. Five of the seven crewmembers were hoisted from the vessel. However, the master and mate remained onboard, attempting to save the vessel. When the helicopter returned the vessel was gone. The mate was found hours later floating in the water in his

immersion suit. The master was recovered from the vessel five days later. He was found in the pilothouse with his immersion suit on. The mate stated that the vessel was struck by a large wave over the stern and sank in less than one minute.